Article by Alexander Graham Bell, August 3, 1891, with transcript

1

Copied from the Beinn Bhreagh Recorder for April 14, 1910. ARTIFICIAL RESPIRATION By Alexander Graham Bell

(The following article was dictated by Mr. Bell at Beinn Bhreagh August 3, 1891 and was taken down by Mr. Arthur W. McCurdy. It has been found preserved in a little volume of Dictated Notes entitled “Half Hour Evening Talks on Various Subjects”. M. B. McC.)

Aug. 3, 1891 :- When by muscular action we enlarge the space within the thorax the air contained within that space becomes less dense, and therefore rarer than the air of the atmosphere outside. Under such circumstances the denser air of the atmosphere forces its way into the lungs until an equilibrium in pressure is established within and without the thorax. This is the completion of an act of inspiration.

In expiration the space within the thorax is reduced by muscular action, the contained air thus being compressed and made more dense than that of the atmosphere outside. Under these circumstances the compressed air in the lungs forces its way out into the atmosphere until an equilibrium of pressure is established.

In ordinary respiration this alternate expansion and contraction of the thoracic cavity is accomplished by the action of certain muscles. The same result would follow if the thoracic cavity could be alternately expanded and contracted by other agencies.

For example:- Place a man in a barrel with the head and shoulders out at one end. Now put the barrel, man and all, into an air-tight bag, the mouth of which is tied tightly under the armpits.

Now, if by any means we can rarefy the air in the barrel, then the 2 denser air of the atmosphere will force its way into the lungs, causing an expansion of the thoracic cavity. The expanding lungs will push out the front wall of the thorax, and push down the diaphragm. The diaphragm, exerting a pressure upon the viscera, will cause them to push out the walls of the abdominal cavity. The whole body of the man will expand because the air inside the body, having free access to the atmosphere, is more dense than the air outside in the barrel.

It will be observed that this action is independent of muscular action, and would therefore take place in the case of a corpse or of a person with suspended animation. That is the rarefaction of the air outside the body would cause air to enter the lungs and expand them, an act of inspiration would result, and fresh air from the outside would penetrate every nook and corner of the lungs.

Now, suppose the operation to be reversed. Let the air in the barrel be compressed so as to be more dense then the air of the atmosphere outside; the thoracic cavity would then become contracted; the superior pressure of the confined air in the barrel would cause compression of the abdominal walls; the contained viscera would push the diaphragm upwards into the cavity of the thorax; the framework of the thorax would also suffer compression, and air would escape into the atmosphere; and an act of expiration would take place.

Making a Corpse Breathe

Thus the alternate rarefaction, and condensation, of the air within the barrel would cause even a corpse to breathe . Can it be doubted that in the case of a person with suspended animation this process would result in restoration to life.

3

The character of the artificial respiration produced would be materially different from that occasioned by the manipulation of the body of the unconscious person.

In manipulating a body we can, by compression of the body cause expulsion of the air from the lungs; but it is more difficult to cause a sufficient expansion of the thoracic cavity to produce a full inspiration ; so that the method of manipulation is apt to fail in cases where there is not vitality left to cause the diaphragm to contract.

The method suggested above, however, is capable of producing a full and deep inspiration quite independently of any muscular contraction in the diaphragm. If the blood is capable of oxygenation we can, by artificial means, occasion that oxygenation by causing fresh air to penetrate into every portion of the lungs. There is no difficulty under any method in causing expiration, the main difficulty lies with inspiration.

The principle involved is this:- Occasion an alternate condensation and rarefaction of the air outside the thorax and abdomen .

A Vacuum Jacket

It is not necessary that the limbs should be included in the confined space. A rigid jacket could be made to fit round the body of the unconscious person leaving the legs and arms exposed, so that the legs and arms could be rubbed in the usual manner to start the circulation while efforts were being made to restore breathing.

The interior of the rigid jacket should be connected with a bellows of considerable capacity; the alternate expansion and contraction of the bellows will 4 affect the density of the air within the jacket, and thus produce breathing.

I had such a jacket made many years ago in England. It was sent to some gentlemen connected with University College in London, who promised to experiment with it. It was not returned to me before my departure for America, and I have lost track of the apparatus

through failure to remember the name of the gentlement to whom it was intrusted.* I have thus been unable myself to experiment upon a human body, but I have by this process induced respiration artificially in drowned cats.

* The apparatus was afterwards recovered and was brought to America. It is preserved in the Museum of Beinn Bhreagh Laboratory. A.G.B. April 10, 1910.

The success of these experiments with small animals led me to bring the subject to the attention of the American Association for the Advancement of Science. I made an address before that body some years ago upon the use of a vacuum jacket as a means of producing artificial respiration. A short abstract was published in the proceedings of the Association's Montreal meeting 188-.

Many children, especially those prematurely born, die from inability to expand their lungs sufficiently when they their first breath. I have no doubt that in many of those cases lives could be saved by starting the respiration artificially by means of apparatus operating in the manner described above.

AGB

Abstract of an address delivered at the Montreal Meeting (1882) of the American Association for the Advancement of Science. Copied from the Proceedings , page 224.

UPON A PROPOSED METHOD OF PRODUCING ARTIFICIAL RESPIRATION BY MEANS OF A VACUUM JACKET. BY ALEXANDER GRAHAM BELL, OF WASHINGTON, D. C. (ABSTRACT)

I propose to surround the waist of the unconscious patient by a rigid jacket or drum somewhat larger in diameter than his body. The appratus can be rendered practically air-tight by a rubber band around the thorax, and another round the loins. Upon exhausting the air inside the drum a partial vacuum is produced around the abdomen. Under such

circumstances the pressure of the atmosphere forces air through the mouth and nose into the thorax causing the depression of the diaphragm and consequent expansion of the abdomen.

The alternate rarefaction and condensation of the air confined around the abdomen thus cause alternate inspiration and expiration.

Vacuum Jacket

1891

In the Scientific American , for October 7, 1905, page 276, under the title: “A Novel Process of Reanimation”, Dr. Alfred Gradenwitz described and illustrated an aparatus designed by Dr. R. Eisenmenger of Szaszvaros, Hungary, to produce artificial breathing by simply acting on the abdomen without producing any motion of the throat.

In the Scientific American for October 28, 1905, page 339, is a letter from Dr. Bell's secretary, Charles R. Cox, reading as follows:

“CORRESPONDENCE”

“The New Process of Resuscitation Proves to Be Old” To the Editor of the Scientific American:

I notice in the Scientific American for October 7, 1905, an article entitled “A Novel Process of Reanimation.”

It might be interesting to you to know that there is in the Proceedings of the American Association for the Advancement of Science a record of an address by Dr. Alexander Graham Bell, presenting over twenty years ago an idea substantially the same as that of Dr. Gradenwitz. I beg to quote an abstract taken from the thirty-first meeting of the above-named society, held at Montreal, Canada, August 1, 1882:

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“I propose to surround the waist of the unconscious patient by a rigid jacket or drum somewhat larger in diameter than his body. The aparatus can be rendered practically airtight by a rubber band around the thorax, and another around the loins. Upon exhausting the air inside the drum, a partial vacuum is produced around the abdomen. Under such circumstances, the pressure of the atmosphere forces air through the mouth and nose into the thorax, causing the depression of the diaphragm and consequent expansion of the abdomen thus cause alternate inspiration and expiration.”

Charles R. Cox. Volta Bureau, Washington, D. C., October 15, 1905.